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Focus . . . Pregnancy Related Mortality in Missouri: 1990 - 1997

The *Healthy People 2000: National Health Promotion and Disease Prevention Objectives* for the United States listed maternal mortality as a priority area for improvement, including specific goals of no more than 3.3 maternal deaths per 100,000 live births overall, and no more than 5.0 maternal deaths per 100,000 live births among black women.[1] The 1990-97 Missouri maternal mortality rate was 14.3 deaths per 100,000 live births. The pregnancy related mortality ratio for black women is over three times higher than for white women in Missouri. This study was conducted to understand the factors associated with the high maternal mortality ratios in Missouri.

Methods

A death was considered to be a potential pregnancy-related death if a) the pregnancy check box, indicating that the woman had been pregnant within 90 days of death, was marked on the death certificate, b) the death certificate otherwise indicated that the woman was pregnant at the time of death, c) the death certificate was matched with a birth certificate or fetal death record for a delivery that occurred within one year before the woman's death, or d) the cause of death was described on the certificate by a key word indicative of pregnancy. A death was classified as pregnancy-related if it resulted from a) complications of pregnancy, b) a chain of events initiated by pregnancy, or c) aggravation of an unrelated condition by the physiologic or pharmacological effects of pregnancy.[2] We excluded deaths associated with neoplasms (exclusive of molar pregnancy) and deaths due to trauma because of the difficulty of determining the relationship of pregnancy in these cases.

Several of the variables on the death certificates were examined including the immediate and underlying causes of death, any associated obstetrical conditions or complications, and the outcome of the pregnancy. Information was obtained from death certificates (including notes written in the margins), autopsy reports, medical records, matched birth and fetal death certificates and contact with the physician of record, medical examiner or coroner in certain ambiguous cases.

Live birth and fetal death certificates were available for most women who delivered a live-born or stillborn infant. These certificates provided information on items such as live birth order and prenatal care status that was not available on the maternal death certificates. Equivalent sources of data were not available for women who had an induced or spontaneous abortion, ectopic pregnancy, or who died without delivery of a live-born or stillborn infant.

Inadequate prenatal care was defined as fewer than five prenatal visits for pregnancies less than 37 weeks fewer than eight visits for those 37 weeks or longer or care beginning after the first four months of pregnancy. We determined Medicaid status from information on the birth or fetal death certificates the only source we had available for this information for all of the years from 1990 through 1997.

Pregnancy-related mortality ratios (PRMRs) were calculated as deaths per 100,000 live births.

Results

A total of 246 potential pregnancy-related deaths were found for the years 1990-1997 using the framework described above. We excluded 156 deaths including 24 due to various neoplasms because the cause of death did not appear to be related to pregnancy.

The overall pregnancy related mortality ratio (PRMR) for the eight

year surveillance period was 14.3 deaths per 100,000 live births. While there appears to be an upward trend in the number of cases year by year as shown in Table 1, the annual number of pregnancy related deaths in Missouri did not vary significantly over time ($p = 0.22$ using the Poisson regression), ranging from seven to fifteen deaths per year.

Black women were 3.4 times more likely to die from pregnancy-related causes than were white women (Table 2). Age was also associated with pregnancy-related mortality, particularly for women aged 35 years and older, who had a 2.5 times higher risk for death than women aged 20-29 years (Table 3).

The most common pregnancy outcome associated with a pregnancy-related death was a live birth (54 percent), followed by an undelivered pregnancy (15 percent), a stillbirth (12 percent), a spontaneous abortion (6 percent), an ectopic pregnancy (5 percent), and an induced abortion (5 percent).

The overall risk for pregnancy-related death among unmarried women was twice as great as that for married women. The PRMR was 21.5 deaths per 100,000 live births for all unmarried women and 10.9 for all married women. The age-adjusted PRMR for unmarried white women was 2.1 times greater than that for married white women, whereas this same ratio for unmarried black women was one half of that for married black women.

Of all the women who died following a live birth in which adequacy of prenatal care was known, four (10 percent) had received no prenatal care and 10 (25 percent) had inadequate prenatal care. The risk of pregnancy-related death was 8.6 times higher for women who received no prenatal care than for women who received adequate care and 2.0 times greater for those who received inadequate prenatal care.

The risk for pregnancy-related death increased with increasing live-birth order, beginning with women delivering their first live-born infant, for all women whose pregnancies resulted in a live birth. The mortality ratio was 1.6 times higher for women following delivery of a third or higher-order live-born infant than for women following a first live birth (10.2 vs. 6.5).

Hemorrhage was the underlying cause of death for 17 (20 percent) women, regardless of pregnancy outcome. Fifteen (17 percent) women died from a pulmonary embolism, and infection was the cause of death for 14 (16 percent) women. Pregnancy-induced hypertension complications were the underlying cause of death for 12 (14 percent) women. Eleven (13 percent) women died from cardiovascular complications and three (4 percent) from anesthesia complications. Fourteen (16 percent) died from other causes.

There were 40 pregnancy-related deaths in the St. Louis region (including only St. Louis City and St. Louis County) compared to 46 in the rest of the state. The PRMR for the region was 24.0 compared to 10.6 for the rest of the state (Table 4). Thus, women residing in the St. Louis region had a 2.3 times greater risk for pregnancy-related death than women from the rest of the state. The risk for pregnancy-related death in the St. Louis region among resident black women was 4.7 times greater than that for resident white women. In comparison with black women from the rest of the state, black women of the St. Louis region had 3.4 times the risk for pregnancy-related death, whereas the risk for pregnancy-related death among white women of the St. Louis region was approximately the same as that for white women from the rest of the state.

PRMRs were elevated for black women in the St. Louis region throughout the study period.

Medicaid status was known for 52 (60 percent) of pregnancy-related deaths. The PRMR for women on Medicaid was 10.8 compared with 8.0 for women not on Medicaid. This 35 percent differential primarily reflected white differentials which were 8.4 for Medicaid compared to 5.9 for non-Medicaid. Black women not on Medicaid had a PRMR

approximately double those of black women on Medicaid: 30.4 versus 15.0 respectively. Among the 38 women delivering a live-born infant in which adequacy of prenatal care was known, nine (43 percent) Medicaid participants received no or inadequate prenatal care compared with one (6 percent) for non-Medicaid participants.

The risk for pregnancy-related death was analyzed with respect to hospital obstetric level for all women who delivered a live-born or stillborn infant. The PRMRs were significantly higher for hospitals which provided Level 3, the highest level of obstetric services. The PRMR for level 1 was 6.1, for level 2 it was 5.3 and it was 10.3 for level 3 hospitals.

Discussion

Readers familiar with Missouri official vital statistics may note that the number of pregnancy-related deaths described here exceeds by 48 percent the 58 maternal deaths included in the published reports for 1990 through 1997. In this analysis a number of additional deaths were found which could be included under the currently prevailing criteria specifying "a chain of events that was initiated by the pregnancy" or "the aggravation of an unrelated condition by the physiologic or pharmacological effects of the pregnancy." These additional deaths were included as maternal deaths based on the more recent medical literature which has established these criteria. Exclusion of deaths due to trauma gives a sharper focus on the more obvious causes of pregnancy-related mortality but may obscure other relationships such as the reported increase in self-inflicted trauma among postpartum women.[3]

Berg et al.[4] in 1996 wrote that "increased efforts to identify pregnancy-related deaths have contributed to an increase in pregnancy-related mortality" but that "more than half of such deaths...are probably still unreported." Sachs et al.[3], reporting on maternal deaths in Massachusetts from 1976 through 1985, found that 43 percent were determined to be preventable by a maternal death review committee. It is uncertain how the current definitions of pregnancy-related deaths would have affected this percentage.

Since relatively high St. Louis black PRMRs occurred throughout the surveillance period of 1990 through 1997, it is unlikely that recent changes in the health care system, such as the implementation of Medicaid Managed Care in late 1995 or the closing of the St. Louis Regional Medical Center in late 1996, were the primary cause of the high St. Louis ratios.

It is not unexpected that the larger hospitals with level 3 obstetric status had higher PRMRs since they provide care for the most difficult and complicated patients.

Public Health Measures

Increased efforts should be made to assure that pregnant women receive prenatal care early in the course of pregnancy. Providers caring for pregnant black women should be mindful of the increased risk of death even for those women who are married. Providers caring for pregnant women aged at least 35 years or those women following delivery of a third or higher-order live-born infant should also be aware of the increased risk of death.

Prenatal and perinatal care should focus on prevention of hemorrhage, pulmonary embolism, infection, pregnancy-induced hypertension, and cardiovascular and anesthesia complications. Consultation with management of these complications and referral of high-risk women should be strongly considered.

The excess of pregnancy-related deaths in Missouri over the goals set by the Healthy People 2000 objectives may be due to potentially preventable conditions such as pregnancy-induced hypertension and infections. Some complications during or shortly after pregnancy may be unanticipated, even in otherwise healthy women receiving exemplary care. Some complications, however, may be due to substance abuse or worsening of existing precarious medical conditions as a consequence of unintended pregnancy. Some complications may arise, or be poorly managed, by virtue of lack of competent obstetrical services due to problems with access to care or due to personal choice. There may be nothing which can be done for some unanticipated rare events. However, substance abuse, unintended pregnancy and availability and quality of services are important public health concerns.

We propose convening an expert group to review each maternal death in a timely manner to assist in the discovery of preventable causes of maternal mortality.[3] Such a group should include obstetricians and perinatologists with expertise in management of high risk pregnancy along with public health experts in maternal health and in epidemiology. It should include representatives from all the academic obstetric centers in the state. Review of each maternal death by such a group could help to classify the deaths as to their relation to pregnancy and to determine the types of deaths that could have been prevented. Review of outpatient and inpatient records could determine whether lapses in quality of care may have been responsible for some deaths. Such information would be valuable in setting priorities and giving guidance to programs for continuing obstetrical education and to other programs to improve care and prevent maternal deaths. It would be desirable to have such a group empowered with legislative authority.

As more is learned about medical prevention of premature birth, the quality of prenatal care will achieve paramount importance as opposed to the present focus on surrogate measures of timing and quantity of prenatal visits. Understanding the problems in the health care system that may contribute to pregnancy related mortality may aid our understanding of the problems with quality of prenatal care.

Conclusion

During 1990-1997, 86 Missouri deaths were determined to be pregnancy-related. The overall PRMR was 14.3 deaths per 100,000 live births, yet there were no statistically significant trends in the annual rates during these years. The PRMR for black women was consistently higher than that for white women for almost every factor examined by race. Older women, particularly women aged 35 years and older, were at increased risk for pregnancy-related deaths. The overall risk for pregnancy-related death among unmarried women was twice as great as that for married women. The risk for pregnancy-related death was 8.6 times higher for women who received no care than for women who received adequate prenatal care. Overall, resident women of the St. Louis region had 2.3 times the risk of pregnancy-related death compared to women from the rest of the state.

Major changes must be made in the care provided to pregnant women if changes are to occur in maternal mortality and in order to reach the desirable goals for the year 2000. Review of individual maternal deaths by an expert group is proposed as a means to this end.

References

1. US Department of Health and Human Services. Healthy People 2000: National health promotion and disease prevention objectives. Washington: PHS. 1990.
2. Koonin LM, MacKay AP, Berg CJ, Atrash HK, Smith JC. Pregnancy-related Mortality Surveillance—United States, 1987-1990. MMWR Surveillance Summaries 1997; 46(No.SS-4):17-36.
3. Sachs BP, Brown DAJ, Driscoll SG et al. Maternal Mortality in Massachusetts. NEJM 1987; 316:667-72.
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Table 1

Number Live Births, Number of Pregnancy-related Deaths, and Pregnancy-related Mortality Ratio (PRMR)*, by Year of Death: Missouri, 1990-1997

Year of death	*Number of live births*	*Number of deaths*	*PRMR*
1990	79,135	9	11.4

1991	78,468	9	11.5
1992	76,005	11	14.5
1993	75,146	7	9.3
1994	73,279	13	17.7
1995	72,804	13	17.9
1996	73,733	15	20.3
1997	73,940	9	12.2
Total	602,510	86	14.3

*Pregnancy-related deaths per 100,000 live births

Table 2

Number of Pregnancy-related Deaths, Pregnancy-related Mortality Ratio (PRMR),* and Risk Ratio, by Race: Missouri, 1990-1997

Race	*Number of deaths*	*PRMR*	*Risk ratio*	*95% CI†*
White	50	10.1	Referent	
Black	34	34.6	3.4	(2.28-4.58)
Other	2	20.0	2.0	(0.00-4.73)
Total	86	14.3		

*Pregnancy-related deaths per 100,000 live births
†Confidence interval

Table 3

Number of Pregnancy-related Deaths, Pregnancy-related Mortality Ratio (PRMR)*, and Risk Ratio, by Age: Missouri, 1990-1997

Age group(yrs)	*Number of deaths*	*PRMR*	*Risk ratio*	*95% CI†*
<20	10	11.6	1.0	(0.37-1.56)
20-29	40	11.9	Referent	
30-34	20	16.0	1.3	(0.75-1.93)
35†	16	29.9	2.5	(1.28-3.74)
Total	86	14.3		

*Pregnancy-related deaths per 100,000 live births
†Confidence interval

Table 4

Number of Pregnancy-related Deaths and Pregnancy-related Mortality Ratio*, by Select Resident Counties and Race: Missouri, 1990-1997

Resident county	*No.*	*White PRMR*	*95% CI†*	*No.*	*Black PRMR*	*95% CI*	*No*	*All Races PRMR*	*95% CI*
St. Louis City	0	0	0	20	54.3	(30.48-78.03)	20	35.6	(20.02-51.25)
St. Louis	10	12.1	(4.59-19.54)	9	35.7	(12.38-59.03)	20	18.0	(10.14-25.95)
Total	10	9.9	(3.76-16.03)	29	46.7	(29.72-63.73)	40	24.0	(16.54-31.38)
Rest of state**	40	10.2	(7.04-13.37)	5	13.8	(1.71-25.98)	46	10.6	(7.51-13.61)

*Pregnancy-related deaths per 100,000 live births
†Confidence interval
**Excludes St. Louis City and St. Louis County

Provisional Vital Statistics for April 1998

Live births increased in April as 6,577 Missouri babies were born compared with 5,688 in April 1997. The birth rate increased from 12.8 to 14.7 per 1,000 population during this time period.

Cumulative births show a decrease for the first four months of the year, but an increase for the 12 months ending with April. Births totaled 74,452 for the 12 months ending with April compared with 73,533 one year earlier.

Deaths decreased for all three time periods shown below. For the first third of the year, deaths decreased 4 percent from 20,090 to 19,292.

The **Natural increase** for Missouri in April was 2,968 (6,577 births minus 3,609 deaths). The natural increase was higher in 1998 for all three time periods shown below.

Marriages decreased for all three time periods shown below. The marriage to divorce ratio decreased for the 12 months ending with April from 1.80 in 1997 to 1.68 in 1998.

Infant deaths decreased for all three time periods shown below. For the 12 months ending with April, the infant death rate decreased from 7.9 to 7.5 per 1,000 live births.

PROVISIONAL RESIDENT VITAL STATISTICS FOR THE STATE OF MISSOURI

Item	April				Jan.-April cumulative				12 months ending with April				
	Number		Rate*		Number		Rate*		Number		Rate*		
	1997	1998	1997	1998	1997	1998	1997	1998	1997	1998	1996	1997	1998
Live Births	5,688	6,577	12.8	14.7	25,296	25,167	14.2	14.1	73,533	74,452	13.7	13.7	13.8
Deaths	4,608	3,609	10.4	8.1	20,090	19,292	11.3	10.8	54,388	54,040	10.1	10.1	10.0
Natural increase	1,080	2,968	2.4	6.6	5,206	5,875	2.9	3.3	19,145	20,412	3.5	3.6	3.8
Marriages	3,069	2,853	6.9	6.4	11,348	10,703	6.4	6.0	45,609	42,940	8.3	8.5	7.9
Dissolutions	2,011	2,006	4.5	4.5	8,047	8,309	4.5	4.6	25,360	25,519	4.8	4.7	4.7
Infant deaths	55	47	9.7	7.1	220	213	8.7	8.5	584	561	7.7	7.9	7.5
Population base (in thousands)	...	...	5,402	5,440	...	...	5,402	5,440	...	...	5,338	5,376	5,414

*Rates for live births, deaths, natural increase, marriages and dissolutions are computed on the number per 1000 estimated population. The infant death rate is based on the number of infant deaths per 1000 live births. Rates are adjusted to account for varying lengths of monthly reporting periods.

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